

5-14-91 JC17 Rec'd PCT/PTO 10 MAY 2001 Pct

FORM PTO-1390
(REV. 11-2000)

U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

ATTORNEY'S DOCKET NUMBER

TRANSMITTAL LETTER TO THE UNITED STATES
DESIGNATED/ELECTED OFFICE (DO/EO/US)
CONCERNING A FILING UNDER 35 U.S.C. 371

R-222.00

U.S. APPLICATION NO. (If known, see 37 CFR 1.5)

09/831680

INTERNATIONAL APPLICATION NO.

PCT/AT99/00271

INTERNATIONAL FILING DATE

10 November 1999

PRIORITY DATE CLAIMED

10 November 1998

TITLE OF INVENTION Pharmaceutical Preparation Comprising a Receptor Antagonist for the Treatment of Blood Coagulation Disorders

APPLICANT(S) FOR DO/EO/US

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Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☐ This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (21) indicated below.
4. ☒ The US has been elected by the expiration of 19 months from the priority date (Article 31).
5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
 - a. ☐ is attached hereto (required only if not communicated by the International Bureau).
 - b. ☒ has been communicated by the International Bureau.
 - c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☒ An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
 - a. ☒ is attached hereto.
 - b. ☐ has been previously submitted under 35 U.S.C. 154(d)(4).
7. ☐ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
 - a. ☐ are attached hereto (required only if not communicated by the International Bureau).
 - b. ☐ have been communicated by the International Bureau.
 - c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
 - d. ☐ have not been made and will not be made.
8. ☐ An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371 (c)(3)).
9. ☐ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. ☒ An English language translation of the annexes of the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)). NOT INCLUDED AS IPER HAS NOT ISSUED TO DATE

Items 11 to 20 below concern document(s) or information included:

11. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☒ A **FIRST** preliminary amendment.
14. ☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
15. ☐ A substitute specification.
16. ☐ A change of power of attorney and/or address letter.
17. ☐ A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821 - 1.825.
18. ☐ A second copy of the published international application under 35 U.S.C. 154(d)(4).
19. ☐ A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).
20. ☒ Other items or information: English translation of substitute pages of amended claims submitted in response to written opinion (IPER not issued to date)

1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040 2041 2042 2043 2044 2045 2046 2047 2048 2049 2050 2051 2052 2053 2054 2055 2056 2057 2058 2059 2060 2061 2062 2063 2064 2065 2066 2067 2068 2069 2070 2071 2072 2073 2074 2075 2076 2077 2078 2079 2080 2081 2082 2083 2084 2085 2086 2087 2088 2089 2090 2091 2092 2093 2094 2095 2096 2097 2098 2099 2100 2101 2102 2103 2104 2105 2106 2107 2108 2109 2110 2111 2112 2113 2114 2115 2116 2117 2118 2119 2120 2121 2122 2123 2124 2125 2126 2127 2128 2129 2130 2131 2132 2133 2134 2135 2136 2137 2138 2139 2140 2141 2142 2143 2144 2145 2146 2147 2148 2149 2150 2151 2152 2153 2154 2155 2156 2157 2158 2159 2160 2161 2162 2163 2164 2165 2166 2167 2168 2169 2170 2171 2172 2173 2174 2175 2176 2177 2178 2179 2180 2181 2182 2183 2184 2185 2186 2187 2188 2189 2190 2191 2192 2193 2194 2195 2196 2197 2198 2199 2200 2201 2202 2203 2204 2205 2206 2207 2208 2209 2210 2211 2212 2213 2214 2215 2216 2217 2218 2219 2220 2221 2222 2223 2224 2225 2226 2227 2228 2229 2230 2231 2232 2233 2234 2235 2236 2237 2238 2239 2240 2241 2242 2243 2244 2245 2246 2247 2248 2249 2250 2251 2252 2253 2254 2255 2256 2257 2258 2259 2260 2261 2262 2263 2264 2265 2266 2267 2268 2269 2270 2271 2272 2273 2274 2275 2276 2277 2278 2279 2280 2281 2282 2283 2284 2285 2286 2287 2288 2289 2290 2291 2292 2293 2294 2295 2296 2297 2298 2299 2300 2301 2302 2303 2304 2305 2306 2307 2308 2309 2310 2311 2312 2313 2314 2315 2316 2317 2318 2319 2320 2321 2322 2323 2324 2325 2326 2327 2328 2329 2330 2331 2332 2333 2334 2335 2336 2337 2338 2339 2340 2341 2342 2343 2344 2345 2346 2347 2348 2349 2350 2351 2352 2353 2354 2355 2356 2357 2358 2359 2360 2361 2362 2363 2364 2365 2366 2367 2368 2369 2370 2371 2372 2373 2374 2375 2376 2377 2378 2379 2380 2381 2382 2383 2384 2385 2386 2387 2388 2389 2390 2391 2392 2393 2394 2395 2396 2397 2398 2399 2400 2401 2402 2403 2404 2405 2406 2407 2408 2409 2410 2411 2412 2413 2414 2415 2416 2417 2418 2419 2420 2421 2422 2423 2424 2425 2426 2427 2428 2429 2430 2431 2432 2433 2434 2435 2436 2437 2438 2439 2440 2441 2442 2443 2444 2445 2446 2447 2448 2449 2450 2451 2452 2453 2454 2455 2456 2457 2458 2459 2460 2461 2462 2463 2464 2465 2466 2467 2468 2469 2470 2471 2472 2473 2474 2475 2476 2477 2478 2479 2480 2481 2482 2483 2484 2485 2486 2487 2488 2489 2490 2491 2492 2493 2494 2495 2496 2497 2498 2499 2500 2501 2502 2503 2504 2505 2506 2507 2508 2509 2510 2511 2512 2513 2514 2515 2516 2517 2518 2519 2520 2521 2522 2523 2524 2525 2526 2527 2528 2529 2530 2531 2532 2533 2534 2535 2536 2537 2538 2539 2540 2541 2542 2543 2544 2545 2546 2547 2548 2549 2550 2551 2552 2553 2554 2555 2556 2557 2558 2559 2560 2561 2562 2563 2564 2565 2566 2567 2568 2569 2570 2571 2572 2573 2574 2575 2576 2577 2578 2579 2580 2581 2582 2583 2584 2585 2586 2587 2588 2589 2590 2591 2592 2593 2594 2595 2596 2597 2598 2599 2600 2601 2602 2603 2604 2605 2606 2607 2608 2609 2610 2611 2612 2613 2614 2615 2616 2617 2618 2619 2620 2621 2622 2623 2624 2625 2626 2627 2628 2629 2630 2631 2632 2633 2634 2635 2636 2637 2638 2639 2640 2641 2642 2643 2644 2645 2646 2647 2648 2649 2650 2651 2652 2653 2654 2655 2656 2657 2658 2659 2660 2661 2662 2663 2664 2665 2666 2667 2668 2669 2670 2671 2672 2673 2674 2675 2676 2677 2678 2679 2680 2681 2682 2683 2684 2685 2686 2687 2688 2689 2690 2691 2692 2693 2694 2695 2696 2697 2698 2699 2700 2701 2702 2703 2704 2705 2706 2707 2708 2709 2710 2711 2712 2713 2714 2715 2716 2717 2718 2719 2720 2721 2722 2723 2724 2725 2726 2727 2728 2729 2730 2731 2732 2733 2734 2735 2736 2737 2738 2739 2740 2741 2742 2743 2744 2745 2746 2747 2748 2749 2750 2751 2752 2753 2754 2755 2756 2757 2758 2759 2760 2761 2762 2763 2764 2765 2766 2767 2768 2769 2770 2771 2772 2773 2774 2775 2776 2777 2778 2779 2780 2781 2782 2783 2784 2785 2786 2787 2788 2789 2790 2791 2792 2793 2794 2795 2796 2797 2798 2799 2800 2801 2802 2803 2804 2805 2806 2807 2808 2809 2810 2811 2812 2

09/831680

JC08 Rec'd PCT/PTO 10 MAY 2001

Docket No.: R-222.00

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: SCHWARZ, et al.) Group Art Unit: (to be assigned)
Application No.: to be assigned) Examiner: (to be assigned)
Filed: filed herewith)
For: PHARMACEUTICAL PREPARATION)
COMPRISING A RECEPTOR ANTAGONIST)
FOR THE TREATMENT OF BLOOD)
COAGULATION DISORDERS) May 10, 2001

Box PCT
Assistant Commissioner for Patents
Washington, D.C. 20231

FIRST PRELIMINARY AMENDMENT

Sir:

To date, the PCT International Preliminary Examination Report has not been received showing the substitute sheets for amended claims 1-12 submitted in response to the written opinion. Our amendment is based on those amended claims 1-12. Prior to examination of the above-referenced patent application, please amend the patent application as follows.

IN THE CLAIMS:

Please amend the following claims.

1. (amended) A pharmaceutical preparation for the treatment of blood coagulation disorders containing at least one pro-protein of blood coagulation selected from the group consisting of factor VIII, von Willebrand factor (vWF) or factor V, and, in addition, a coagulation physiologically inert receptor binding competitor

selected from the group consisting of RAP, a RAP mutant, a RAP analogue and the combination of tissue type plasminogen activator (tPA) and aprotinin.

2. (amended) A preparation according to claim 1, characterized in that said pro-protein is derived from a biological material selected from the group consisting of human plasma, a plasma fraction and a cell culture supernatant.

3. (amended) A preparation according to claim 1, characterized in that it is provided as a set comprising

- a) said pro-protein of blood coagulation and
- b) said receptor binding competitor.

4. (amended) A preparation according to claim 1, characterized in that said pro-protein of blood coagulation is factor VIII and said receptor binding competitor is a mixture of aprotinin and tPA.

5. (amended) A preparation according to claim 1, characterized in that said pro-protein of blood coagulation is vWF and said receptor binding competitor is a mixture of aprotinin and tPA.

7. (amended) A method of treating a patient suffering from phenotypic coagulation factor deficiency, comprising the step of administering a composition according to claim 1 to said patient.

8. (amended) The method according to claim 7, further comprising the step of selecting a patient who is vWF deficient.

Please cancel claim 9 without prejudice or disclaimer of the subject matter contained therein.

10. (amended) The method of claim 7, wherein said receptor binding competitor is a mixture of aprotinin and tPA.

11.(amended) The method of claim 7, wherein said pro-protein is blood coagulation factor VIII.

Please cancel claim 12 without prejudice or disclaimer of the subject matter contained therein.

CONCLUSION

In view of the foregoing, Applicants believe that all claims now pending in this application are in condition for examination. If a telephone conference would expedite prosecution of this application, the Examiner is invited to telephone the undersigned attorney at (949) 250-6828.

Respectfully Submitted,



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PHARMACEUTICAL PREPARATION COMPRISING A RECEPTOR ANTAGONIST FOR
THE TREATMENT OF BLOOD COAGULATION DISORDERS

[0001] The invention relates to a pharmaceutical preparation based on blood coagulation proteins and measures to extend their biological half-lives.

[0002] Therapeutic proteins, particularly preparations for the treatment of blood coagulation disorders, which contain blood coagulation proteins, such as e.g. von Willebrand factor (vWF), often have relatively short half-lives in the organism. Therefore, therapeutic administrations of such preparations may become ineffective within a short period of time or, at least, their effectiveness may be greatly reduced.

[0003] A lot of what is involved in the physiological degradation pathways of blood coagulation proteins is unknown, just like the exact factors determining their half-lives in the organism.

[0004] The only known fact is that activated factor VIII binds to the lipoprotein receptor related protein (LRP) via its A2 domain, said binding being responsible for internalizing factor VIII as well as for degrading it. It is also known that the internalization of the A2 domain may be inhibited by a receptor associated protein (RAP), an LRP inhibitor, and it is assumed that the dissociation of the A2 subunit from the rest of the activated factor VIII molecule is reversible.

[0005] The low density lipoprotein related protein is a multifunctionally endocytotically active receptor which binds structurally and functionally different ligands and is capable of endocytosis. RAP (receptor associated protein) inhibits all interactions of ligands with LRP *in vitro*.

[0006] It is assumed that, in principle, this mechanism may be important in regulating factor VIIIa activity (Blood 90 (10), Suppl. 1: 31a (1997)).

[0007] It is also known that LRP may act as a clearance receptor for tissue plasminogen activator (tPA), which means that it is responsible for its removal from blood circulation. Moreover, further receptors, such as e.g. the mannose receptor, seem to be of importance there as well. On the other hand, it is known that LRP may be involved in the clearance of many different ligands, such as proteinases, inhibitors, their complexes with proteinases, and various lipoproteins. LRP may be present both in cell-bound and in soluble form (Quinn K.A. et al., XVIIth Congress of the International Society of Thrombosis and Haemostasis, 1999, abstract).

[0008] It has been found that tPA is cleared from blood circulation very quickly and that tPA mutants and clearance inhibitors may be used to reduce the dosage of tPA in thrombolysis therapy (Fibrinolysis and Proteolysis (1997), pp. 173-186).

[0009] In RAP deficient mice it has been demonstrated that α_2 -macroglobulin clearance in the liver is disturbed. It has also been found that the amount of mature processed LRP is reduced in both the liver and the brain (PNAS, 92 (1995), pp. 4537-4541).

[0010] EP-0 713 881-A2 describes von Willebrand factor (vWF) concentrates in combination with antithrombolytic agents and/or fibrinolytic agents. The purpose of these preparations is to reduce the risks of hemorrhages in anticoagulation therapy.

[0011] US 5 304 383 describes a pharmaceutical preparation containing lys-plasminogen in combination with a serine protease inhibitor, such as aprotinin or α_2 -macroglobulin, which may be used for the treatment of plasminogen deficiency and thromboses.

[0012] The object of the invention is to provide a pharmaceutical preparation based on a blood coagulation protein characterized by an improved half-life *in vivo*. In addition, the object of the invention is to extend the *in vivo* half-life of a blood coagulation protein in order to, on the one hand, stabilize the endogenous content of this blood coagulation protein and, on the other hand, increase the efficiency of an exogenous blood coagulation protein.

[0013] According to the present invention said object is realized by a pharmaceutical preparation for the treatment of blood coagulation disorders, which preparation contains at least one protein selected from the group of a pro-protein of blood coagulation. In addition, said pharmaceutical preparation is characterized in that it contains a receptor binding competitor, which, by itself, is coagulation physiologically inert, such as e.g. lipoproteins. Thus, the action of the protein on blood coagulation is not directly influenced, and the receptor binding competitor only contributes to stabilizing said protein *in vivo*.

[0014] In the preparation according to the present invention the protein preferably is a blood coagulation protein selected from the group of factor II, V, VII, VIII, IX, X, XI, XII, vWF and protein C. These proteins are the pro-forms of the coagulation physiologically effective active forms. For example, factor II (prothrombin) is the pro-form of coagulation active thrombin, which enzymatically cleaves fibrinogen to fibrin and thus causes a blot clot. Among these proteins are, on the one hand, the vitamin K dependent proteins, which are also present in a prothrombin complex preparation based on factors II, IX and X and optionally factor VII and protein C. In addition, vWF or its analogue proteins are possible proteins in the preparation according to the present invention, too. Particularly in platelet rich plasma vWF proves that it is effective as a blood coagulation factor by itself, independent of its role as a carrier and stabilizer of factor VIII (Beguin et al., Thrombosis and Haemostasis 78 (1), 590-594 (1997)). vWF is e.g. derived from plasma or a plasma fraction, but it may also be prepared by recombinant DNA technology by way of expression of a

transformed cell. For example, a recombinant vWF is prepared according to the teachings of Pannekoek (EP 0 197 592) or Fischer et al. (WO 96/10584), respectively.

[0015] The group of blood coagulation zymogens or precursors of the coagulation physiologically active blood coagulation proteins may, on the one hand, be derived from plasma or a plasma fraction and correspond to the native proteins. On the other hand, the native proteins or their derivatives may also be derived from cell culture supernatants. In this process, the cells are preferably transformed by means of recombinant DNA technology in order to obtain the recombinant forms of the blood coagulation proteins.

[0016] Mutants or analogues are contained in the preparation according to the present invention as long as they may be used in the treatment of blood coagulation disorders and may bind to a receptor functionally, i.e. competitively.

[0017] Particularly the lipoprotein receptor, or LRP, may be mentioned as a receptor for the proteins of the preparation according to the present invention. Another receptor to which the proteins bind is e.g. the mannose receptor. Surprisingly it has been found that according to the present invention the ligands of LRP demonstrate a positive effect *in vivo* particularly for pro-proteins of blood coagulation as these ligands competitively bind to the receptor. This came as a surprise, because it could not be anticipated that pro-proteins of blood coagulation and vWF are able to bind to LRP. LRP had mainly been known for binding enzymes or their complexes with inhibitors. Thanks to the competitive nature of their binding to LRP, premature binding of the protein in the pharmaceutical preparation or of the endogenous blood coagulation zymogen and vWF are inhibited, which considerably improves biological availability.

[0018] A number of proteins may be used as receptor binding competitors, with those being preferred whose physiological tolerance has been tested.

[0019] According to the present invention, the receptor binding competitor is preferably selected from the group of enzymes, particularly tissue type plasminogen activator (tPA), urokinase (u-PA), pro-urokinase (pro-u-PA), lipoprotein lipase (LPL) and kallikrein; inhibitors, particularly plasminogen activator inhibitor-1 (PAI-1), tissue factor pathway inhibitor (TFPI) and aprotinin; enzyme inhibitor complexes, particularly t-PA-PAI-1, u-PA-PAI-1 and thrombin-PAI-1, α_2 -macroglobulin proteinase (fast form) α_2 M, α_2 M, pregnancy zone protein proteinase, elastase- α^1 -antitrypsin, thrombin antithrombin III, thrombin heparin-cofactor II and u-PA-protease nexin I; lipoproteins, particularly low density lipoprotein (LDL), apolipoprotein E enriched β -very low density lipoprotein, (apo E- β -VLDL), LPL enriched VLDL (LPL-VLDL) and LPL enriched β -VLDL (LPL- β -VLDL); matrix proteins, particularly thrombospondin 1 and 2; toxins and viruses, particularly pseudomonas endotoxin A, and minor group human rhinovirus; or other ligands, particularly apolipoprotein E (apo E), lactoferrin, receptor associated protein (RAP), FVIII and vWF.

[0020] The ligand acting competitively is preferably selected from those physiological proteins which are preferably present as (human physiological) extracellular proteins in the circulation. They may be used in their native forms or as analogues characterized by their binding to the receptor.

[0021] Preferably the ligands acting competitively are RAP or a derivative thereof. Particularly preferred is a RAP fragment comprising the domain which keeps proteins from binding to LRP and thus inhibits internalization and clearance of the proteins (I. Warshawsky et al., J. Biol. Chem., 1993, vol. 15, pp. 22046-22054; Bu G., EMBO J., 1995, vol. 14, pp. 2269-2280). They may be RAP or a derivative thereof of human origin, or animal RAP or a derivative thereof, e.g. from mice, rats or other animals.

[0022] In order not to impair the effect of the pharmaceutical preparation or the endogenous proteins, respectively, said receptor binding competitor is selected

from the coagulation physiologically inert proteins, among which are, for example, low density lipoprotein (LDL) and apolipoprotein.

[0023] Mixtures of receptor binding competitors may also be used as said coagulation physiologically inert receptor binding competitors which, as mixtures, though probably not as single proteins, do not exert any undesired influences on the coagulation system. Examples for such mixtures are thrombin with ATIII or with heparin cofactor II, or with plasminogen activator inhibitor-1 (PAI-1), and elastase and α_1 -antitrypsin, tPA with PAI-1. For example, a preferred mixture is tPA with aprotinin, which is highly suitable for stabilizing e.g. factor VIII *in vivo*. This means that, in this case, the selected receptor binding competitor is a ligand whose coagulation physiological activity is inhibited, optionally by antagonizing with the respective inhibitor.

[0024] Instead of a mixture of a, in principle, effective receptor binding competitor and a suitable antagonist, a mutated form of said receptor binding competitor may be used, too, which competitor is inactivated by suitable mutations (e.g. in the active center) (whose affinity to the receptor, however, is not essentially changed (reduced)). Examples are mutated forms of tPA, urokinase, kallikrein, renin, thrombin (WO 96/41868) etc., among others.

[0025] It came as a surprise that recombinant tPA (rtPA) stabilized the endogenous factor VIII content in a vWF deficient dog over a longer period of time, which allowed for hemophilia treatment. Although the natural stabilizer of factor VIII, i.e. vWF, was lacking, the LRP ligand, or the mixture of LRP ligands, respectively, was able to take over the role of vWF. The factor VIII content was increased by about 50% and remained at that level for several days. The enzyme tPA is a known ligand of LRP. The administration of rtPA to a mammal blocks LRP and thus inhibits metabolic degradation of the coagulation factors, such as e.g. factor VIII. This blocking effect is yet increased by aprotinin. The effect of aprotinin alone was also demonstrated in a

vWF deficient dog which received a combination of rvWF and aprotinin. This lead to a rise in the factor VIII level over a longer period of time.

[0026] Another preferred receptor binding competitor is aprotinin, which is excellently suitable for stabilizing vWF. For example, aprotinin may not only contribute to improved biological availability in a vWF preparation, but, administered as a single active substance, it may also contribute to improving the condition of a vWF deficient patient.

[0027] In many cases a patient suffering from a certain protein deficiency will be treated with the respective receptor binding competitor in order to provide the possibility of formation of the endogenous protein or to stabilize the protein, respectively. This is possible in patients suffering from phenotypic coagulation protein deficiency.

[0028] The preparation according to the present invention, or the active substances mentioned above, respectively, are preferably used as treated preparations or proteins, respectively, in order to rule out any transfer of potentially present pathogens, such as viruses or prions (TBE). If they are derived from biological materials, such as blood, plasma, plasma fractions or cell cultures, they carry the risk of contamination with human pathogens, which risk, however, may be eliminated by a suitable inactivation or depletion treatment. Among the effective measures for virus inactivation are, for example, treatment with organic solvents and/or detergents (EP-O 131 740, EP-O 050 061, virus inactivating eluent), treatment with chaotropic means (WO 90 15 613) heat treatment processes, preferably in lyophilized, dry or wet state (cf. EP-O 159 311), combination processes, such as that in EP-O 519901, and physical methods. The latter lead to virus inactivation e.g. by exposure to light, e.g. in the presence of photo sensitizers (EP-O 471 794 and WO/AT 97/00068).

[0029] Among the human pathogen depletion processes are, in particular, filtrations using ultrafilters, deep-bed filters or nanofilters (A 341/98). In addition, precipitation steps and other protein purification measures, such as adsorption, also contribute to the depletion of probably present pathogens.

[0030] On the one hand, the preparation according to the present invention may be provided as a ready-to-use formulation, i.e. as a mixture of the protein with the receptor binding competitor. On the other hand, it is also possible to provide a set containing A) the protein, and B) the receptor binding competitor. Said set has the advantage that the doses of the various components are variable and that the way of administration may be adapted to the prevailing circumstances. For example, apart from i.v. administration, intramuscular, subcutaneous or oral administration of the active substances is possible, too. The active substances may be administered to the patient together, i.e. simultaneously, or in parallel or consecutively. If a set is used, the preparation according to the present invention is preferably provided in ready-to-use syringes containing the individual components.

[0031] An indication according to the present invention for the preparation is, for example, the treatment of a patient suffering from phenotypic coagulation factor deficiency, e.g. a vWF deficient patient. According to the present invention, a preparation is prepared based on the coagulation factor the patient is lacking, using the combination according to the invention of the receptor binding competitor. Moreover, the receptor binding competitor alone also corresponds to the indication according to the present invention. For example, in case of functional factor VIII deficiency, the receptor binding competitor for factor VIII is administered, which may be a mixture of tPA and aprotinin.

[0032] Another object of the present invention is the use of an LRP ligand preparation for the preparation of a means to treat phenotypic coagulation factor

deficiency (e.g. vWF, factor VIII or factor IX deficiency) or to increase the biological half-life of a protein.

[0033] The invention will be explained in greater detail using the following examples and drawings, to which, however, it is not restricted.

Fig. 1 shows factor VIII determination in a vWF deficient dog

Fig. 2 shows vWF and factor VIII determination in a vWF deficient dog

EXAMPLES

EXAMPLE 1:

[0034] A male Kooiker dog suffering from severe type 3 von Willebrand factor deficiency (Rieger et al., Thromb. Haemost. (1998), 80: 332-337), 8,5 kg of body weight, 2 years old, was anesthetized using 10 mg/kg body weight of ketamine (Ketasol, Dr. E. Gräub AG, Bern, Switzerland) and 1 mg/kg body weight of xylaxine (Xylasol, Dr. E. Gräub AG, Bern, Switzerland). Subsequently, a permanent venous access via a lower arm was established, and aprotinin (Pantinol 100.000 K.I.E. vials, Gerot Pharmazeutika, Vienna, Austria) at a dose of 10 000 K.I.E. per kg of body weight was administered as a bolus via a hollow needle. Then recombinant tissue plasminogen activator (Actilyse, Boehringer Mannheim) (rtPA) was reconstituted using distilled water according to the producer's instructions, and a dose of 0.25 mg/kg body weight was administered the von Willebrand deficient dog as a bolus. At the same time, a blood sample on citrate was taken. Within the first hour of treatment a co-infusion of aprotinin (3000 K.I.E. per kg of body weight) and rtPA 0.75 mg/kg body weight was administered, and after one hour this was exchanged for an infusion containing aprotinin at a dose of 3000 K.I.E. per kg of body weight and 0.5 mg/kg body weight of rtPA, which infusion was administered for one hour. After that, i.e. after two hours, aprotinin was infused for another hour at a dose of 3000 K.I.E./kg body weight. At the time points of 30 min, 1, 3, 24, 48, 92, and 96 hours after the beginning of the experiment blood samples were taken on citrate, platelet depleted

plasma was prepared from them by means of centrifugation, and they were deep-frozen at -20°C and stored until further analysis.

[0035] After completion of the infusion experiment, blood coagulation factor VIII was determined quantitatively in the frozen blood samples using two different determination methods. Firstly, the two step coagulation method according to the method of Austen, D.E.G. and Rhymes, I.L., A Laboratory Manual of Blood Coagulation, Oxford, U.K., Blackwell Scientific (1975) was employed using the reagents of the two step factor VIII test kit of IMMUNO AG, Vienna, Austria. Secondly, factor VIII was determined using the chromogenic factor VIII test kit, Immunochrom FVIII:C of Immuno AG, Vienna, Austria (Lang H., Oberreiter M., Moritz, B., Thromb. Haemost. 65: 943 (1991)). Factor VIII was measured with respect to a human plasma factor VIII standard, which had been calibrated against the Third International Standard 91/666. Factor VIII activity is expressed in human factor VIII units per ml. The result of this determination is summarized in fig. 1. Both factor VIII determination methods, which were carried out independently of each other, showed a rise in factor VIII plasma activity which lasted over a period of 24 to 48 hours and then remained stable at a level of about 150% of the initial level for a period of up to 96 hours after the beginning of the experiment, irrespective of the test method used. As von Willebrand factor is known to be sensitive against proteolytic degradation by plasmin, it had to be assumed that the administration of rtPA would result in an increase in von Willebrand factor inactivation in combination with a secondary reduction of the plasma factor VIII level due to a lack in factor VIII stabilizing protein. The simultaneous administration of aprotinin as an inhibitor of fibrinolysis and of plasmin only gave rise to the expectation that the rtPA effect would be inhibited. The seemingly paradoxical rise in the plasma factor VIII level can therefore only be explained by the interference of aprotinin and/or rtPA with the factor VIII metabolizing mechanisms.

EXAMPLE 2:

[0036] A von Willebrand factor deficient dog as in example 1 was anesthetized and subsequently primed with aprotinin (Pantanol) at a dose of 100.000 K.I.E. as an intravenous bolus. Then the animal was given a recombinant von Willebrand factor preparation at a dose of 70 RcoF E/kg. The preparation and characterization of the recombinant von Willebrand factor preparation is described in Fischer et al., FEBS Lett. 375: 259 (1995). Immediately after the administration of the recombinant von Willebrand factor preparation, an infusion of 100.000 K.I.E. of aprotinin was administered intravenously over a period of three hours. Blood samples on citrate were taken prior to the beginning of the experiment (= time 0), 15 min, 30 min, 1 h, 3 h, 24 h, and 48 h after treatment with recombinant von Willebrand factor, and plasma was prepared therefrom as described in example 1 and deep-frozen at -20°C until further analysis. Then von Willebrand factor antigen was measured in these samples using a rabbit anti-human von Willebrand factor antibody with the test Asserachrom vWF, Boehringer Mannheim. In addition, ristocetin cofactor activity was determined by ristocetin induced aggregation of formaldehyde fixated human blood platelets and according to the method of Evans and Austen, Brit. J. Haematol. 37: 289 (1977). A human plasma standard served as von Willebrand factor standard. In addition, factor VIII was tested as described in example 1. The results of the blood sample determinations of von Willebrand factor and factor VIII activity are shown in Fig. 2. In this figure a mean level of factor VIII activity, determined according to the two factor VIII determination methods, is given as a graph. As known from literature (Turecek et al., Blood 90: 3555 (1997)), von Willebrand factor was eliminated at a half-life of 10 to 20 hours, so that after 48 hours von Willebrand factor was hardly detectable in the circulation. Simultaneously with the administration of recombinant von Willebrand factor and aprotinin, the plasma factor VIII level rose to about 150% of the initial level within 3 h and remained stable at this level or even showed a slightly rising tendency up to 48 h post administration. This result may also be interpreted as in example 1, which means that by the administration of aprotinin the factor VIII plasma level remains increased due to the interference with factor VIII metabolism, although factor VIII is not stabilized by recombinant von Willebrand factor.

EXAMPLE 3:

EFFECT OF RAP ON FACTOR VIII OBTAINED IN KNOCK-OUT MICE SUFFERING FROM SEVERE FACTOR VIII DEFICIENCY

[0037] By means of genetic engineering a mouse strain was created suffering from severe factor VIII (FVIII) deficiency by purposefully disrupting the mouse factor VIII gene according to Bi et al., Nature Genetics 10: 119-121 (1995). Factor VIII knock-out mice were created by inserting a neo-gene at the 3'-end of exon 17 of the mouse factor VIII gene. The relevant male animals (X'Y) had non-detectable factor VIII levels of $< 0,02 \pm 0,01$ E/ml when measured using either a chromogenic factor VIII test, Hyland Immuno, Vienna, Austria, as recently described (Turecek et al., Thromb. Haemostas. Suppl. 769 (1997)) or an antigen-ELISA as described below.

[0038] Two relevant hemizygous male mice (X'Y) were treated intravenously with a dose of 200 E/kg of body weight of a recombinant human factor VIII (rhFVIII) preparation derived from Chinese hamster ovary cells, which had been prepared as described (PCT WO/85/01961) and formulated pharmaceutically without stabilizing protein.

[0039] One hour after said treatment, the tail ends of the anesthetized mice were cut in with the blade of a scalpel as described by Novak et al., Brit. J. Haematol. 69: 371-378 (1998). A volume of 50 μ l of blood was collected by means of capillary tubes (Ringcaps, Hirschmann, Germany) from the tail wounds, said capillary tubes being coated with lithium heparin as anticoagulant. The capillary tubes were sealed and centrifuged in order to separate the blood cells from the plasma. Then the capillary tubes were opened, and the cell and plasma fractions were collected by further centrifugation. Finally the plasma samples were subjected to factor VIII determination using factor VIII antigen ELISA, test set IMMUNOZYM FVIII Ag, Hyland Immuno, Vienna, Austria, using monoclonal antifactor VIII antibodies for scavenging as well as for detection, as described (Stel et al., Nature 303: 530-532 (1983); Lenting et al., J. Biol. Chem. 269: 7150-7155 (1994); Leyte et al., Biochem. J. 263: 187-194

(1989)). The resulting factor VIII levels were expressed in international units of human factor VIII. The results of the factor VIII plasma levels are given in the table.

[0040] Two other relevant male hemizygous mice (X^hY) were primed with recombinant receptor associated protein (GST-RAP) at a dose of 40 mg/kg body weight 10 min prior to treatment with the recombinant human factor VIII. The receptor-related protein (RAP) used in this study, which interacts with the low density lipoprotein receptor, was obtained by bacterial fermentation as described by Hertz et al., J. Biol. Chem. 266: 21232-21238 (1991). A fusion protein of RAP with glutathione-S-transferase was expressed in E. coli and purified by means of affinity chromatography on glutathione agarose. The resulting protein was mainly comprised of the fusion protein and cleavage products of RAP and glutathione-S-transferase. The fusion protein was formulated in an injectable buffer ready for administration to the factor VIII knock-out mice. As in the control group (treatment with only factor VIII),

blood samples were taken one hour after administration of recombinant factor VIII and measured for factor VIII activity using factor VIII antigen ELISA. The results are given in the table.

	treatment	dosage	obtained 1 h after treatment
mouse No.	GST-RAP	rhFVIII	FVIII:Ag (E/ml plasma)
1	40 mg/kg	200 E/kg	1.92
2	40 mg/kg	200 E/kg	1.88
3	-	200 E/kg	0.73
4	-	200 E/kg	0.83

In mice primed with GST-RAP, factor VIII was obtained at a level of more than 200% of the plasma levels after treatment with recombinant factor VIII alone.

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(N E W) C L A I M S :

1. A pharmaceutical preparation for the treatment of blood coagulation disorders containing at least one pro-protein of blood coagulation, selected from the group of factor VIII, von Willebrand factor (vWF) or factor V, and, in addition, a coagulation physiologically inert receptor binding competitor selected from the group of RAP, a RAP mutant, a RAP analogue and the combination of tissue type plasminogen activator (tPA) and aprotinin.

2. A preparation according to claim 1, characterized in that said pro-protein is derived from a biological material selected from the group of human plasma, a plasma fraction and a cell culture supernatant.

3. A preparation according to claim 1 or 2, characterized in that it is provided as a set containing

- a) said pro-protein of blood coagulation and
- b) said receptor binding competitor.

4. A preparation according to any one of claims 1 to 3, characterized in that said pro-protein of blood coagulation is factor VIII and said receptor binding competitor is a mixture of aprotinin and tPA.

5. A preparation according to any one of claims 1 to 3, characterized in that said pro-protein of blood coagulation is vWF and said receptor binding competitor is a mixture of aprotinin and tPA.

6. A combination preparation containing aprotinin and tPA for medical use.

7. The use of a preparation according to any one of claims 1 to 5 for the preparation of a means to treat a patient suffering from phenotypic coagulation factor deficiency.

8. The use according to claim 7, characterized in that said patient is vWF deficient.

9. The use of a preparation according to any one of claims 1 to 5 for the preparation of a means to extend the biological *in vivo* half-life of said protein.

10. The use of a preparation according to claim 9 containing aprotinin and tPA.

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11. The use according to claim 9, characterized in that said protein is blood coagulation factor VIII.

12. The use of a pharmaceutical preparation containing a coagulation physiologically inert receptor binding competitor selected from the group of RAP, a RAP mutant, a RAP analogue and the combination of tissue type plasminogen activator (tPA) and aprotinin to extend the biological half-life of a protein selected from the group of factor VIII, factor V and vWF.

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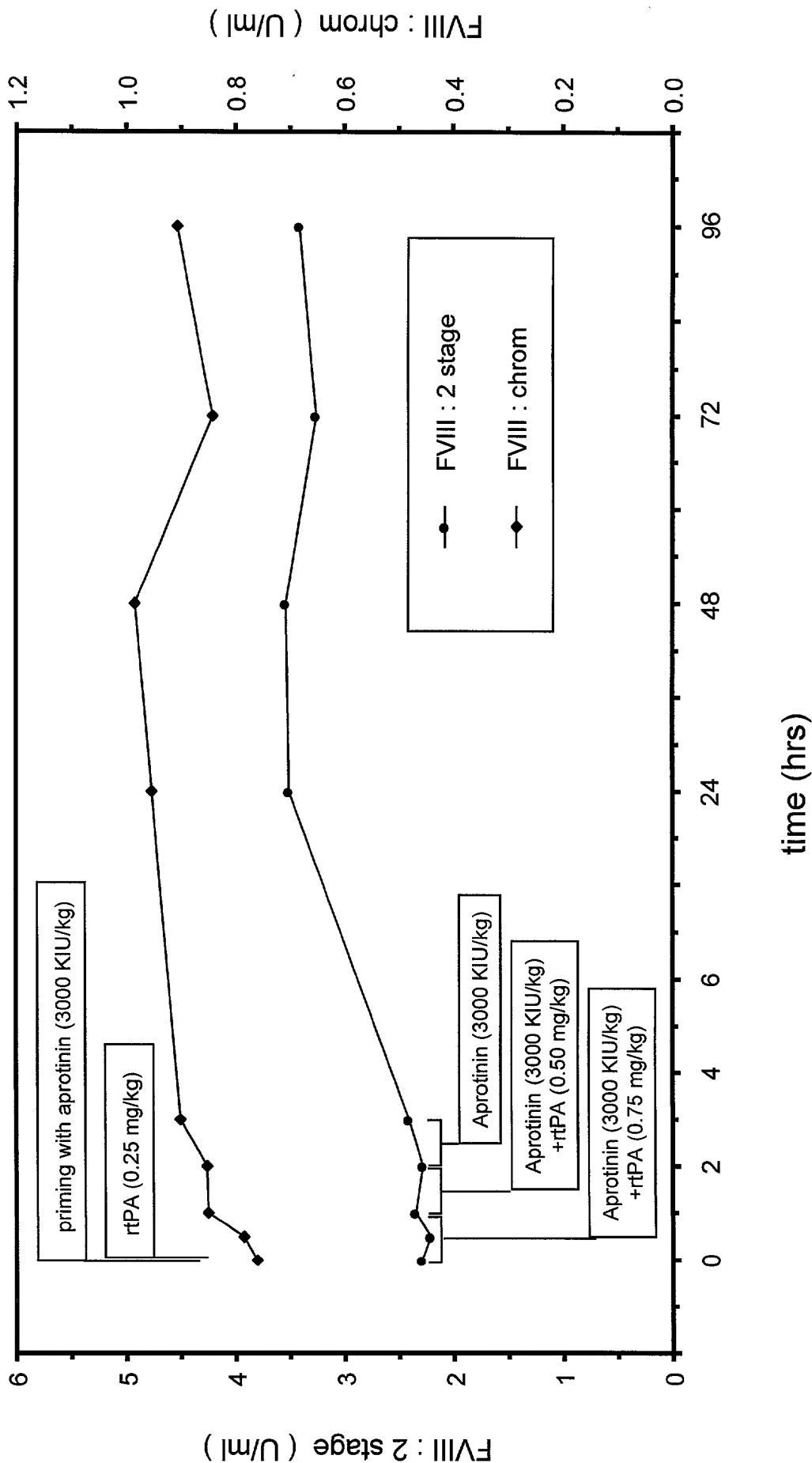
Pharmaceutical preparation comprising a receptor antagonist for the treatment of blood coagulation disorders

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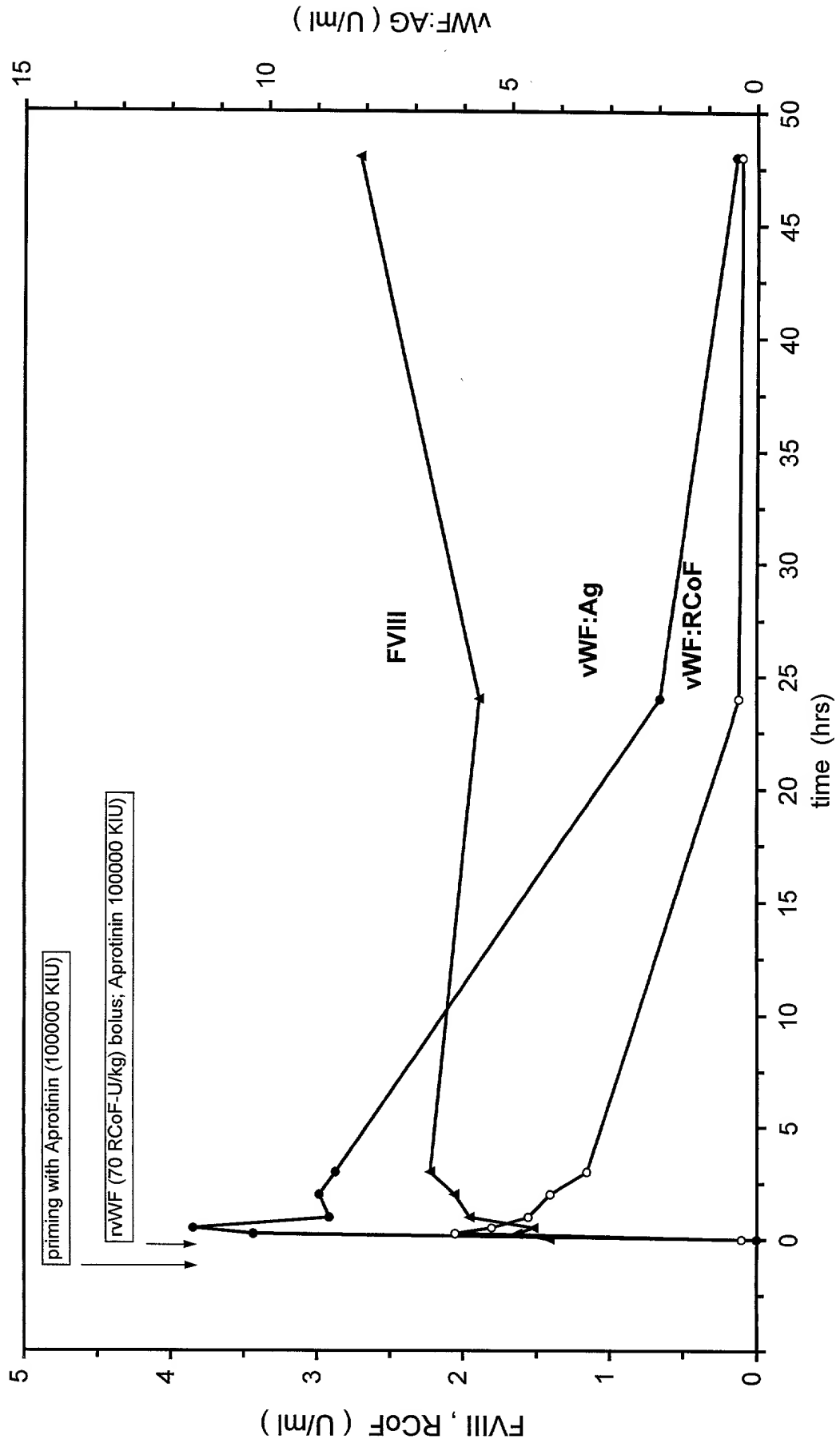
A pharmaceutical preparation for the treatment of blood coagulation disorders, characterized in that it contains at least one protein, selected from the group of pro-proteins of blood coagulation, and a coagulation physiologically inert receptor binding competitor, and its medical use are described.

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Effect of Aprotinin and rtPA in a vWF-deficient dog



Effect of Aprotinin and rVWF in a vWF-deficient dog



Docket No. R-222.00

DECLARATION - UTILITY OR DESIGN PATENT APPLICATION
(37 CFR 1.63)

As a below named inventor, I hereby declare that:

My Residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and joint inventor of the subject matter which is claimed and for which a patent is sought on the invention entitled PHARMACEUTICAL PREPARATION COMPRISING A RECEPTOR ANTAGONIST FOR THE TREATMENT OF BLOOD COAGULATION DISORDERS, the specification of which hereto

(check ☐ is attached
one)

☒ was filed on May 10, 2001 as Application Serial No. 09/831,680 or PCT International Application Number _____ and was amended on _____ (if applicable)

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment specifically referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56.

I hereby claim foreign priority benefits under 35 U.S.C. 119(a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT International application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or of any PCT international application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application Nos.	Country	Foreign Filing Date (MM/DD/YYYY)	Priority Not Claimed	Certified Copy Attached?	
				YES	NO
A1873/98 PCT/AT99/00271	Austria PCT	11/10/1998 11/10/1999	<input type="checkbox"/>	<input type="checkbox"/>	X
			<input type="checkbox"/>	<input type="checkbox"/>	X
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

I hereby claim the benefit under 35 U.S.C. 119(e) of any United States provisional application(s) listed below.

Application Number(s)	Filing Date (MM/DD/YYYY)

I hereby claim the benefit under 35 U.S.C. 120 of any United States application(s) or 365 (c) of any PCT international application designating the United States of America, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in prior United States or PCT international application in the manner provided by the first paragraph of 35 U.S.C. 112, I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

U.S. Parent Application or PCT Parent Number	Parent Filing Date (MM/DD/YYYY)	Parent Patent Number (if applicable)

Docket No. R-222.00

DECLARATION - UTILITY OR DESIGN PATENT APPLICATION
(37 CFR 1.63)

As a named inventor, I hereby appoint the following registered practitioner(s) to prosecute this application and to transaction all business in the Patent and Trademark Office connected therewith: Michael C. Schiffer, Reg. No. 30,215, Michael F. Fedrick, Reg. No. 36,799, C. Joseph Faraci, Reg. No. 32,350 and Janice Guthrie, Reg. No. 35,170.

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

<p>Name of Sole or First Inventor: <u>Hans-Peter Schwarz</u></p> <p>Inventor's signature: <u>[Signature]</u></p> <p>Date: <u>Dec. 7. 2001</u></p> <p>Residence: <u>Schindlergasse 32</u> <u>Vienna, Austria A-1180</u> <i>ATX</i></p> <p>Citizenship: Austrian</p> <p>Post Office Address: same</p>	<p>Name of Second joint Inventor: <u>Peter Turecek</u></p> <p>Inventor's signature: <u>[Signature]</u></p> <p>Date: <u>Dec 10. 1. 2001</u> <i>2-46</i></p> <p>Residence: <u>Weidling, Hauptstrasse 59 g</u> <u>Klosterneuburg, Austria A-3400</u> <i>ATX</i></p> <p>Citizenship: Austrian</p> <p>Post Office Address: same</p>
<p>Name of Third joint Inventor: <u>Bernd Binder</u></p> <p>Inventor's signature: _____</p> <p>Date: _____</p> <p>Residence: <u>Freyung 6/6/9</u> <u>Vienna, Austria A-1010</u> <i>ATX</i></p> <p>Citizenship: Austrian</p> <p>Post Office Address: same</p>	

Docket No. R-222.00

DECLARATION - UTILITY OR DESIGN PATENT APPLICATION
(37 CFR 1.57)

As a below named inventor, I hereby declare that:

My Residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and joint inventor of the subject matter which is claimed and for which a patent is sought on the invention entitled **PHARMACEUTICAL PREPARATION COMPRISING A RECEPTOR ANTAGONIST FOR THE TREATMENT OF BLOOD COAGULATION DISORDERS**, the specification of which hereto(check ☐ is attached
one)[X] was filed on May 10, 2001 as Application Serial No. 09/831,680 or PCT International Application Number _____ and was amended on _____ (if applicable)

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment specifically referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56.

I hereby claim foreign priority benefits under 35 U.S.C. 119(a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT International application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or of any PCT international application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application Nos.	Country	Foreign Filing Date (MM/DD/YYYY)	Priority Not Claimed	Certified Copy Attached?	
				YES	NO
A1873/98	Austria	11/10/1998	<input type="checkbox"/>	<input type="checkbox"/>	X
PCT/AT89/00271	PCT	11/10/1999	<input type="checkbox"/>	<input type="checkbox"/>	X
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

I hereby claim the benefit under 35 U.S.C. 119(e) of any United States provisional application(s) listed below.

Application Number(s)	Filing Date (MM/DD/YYYY)

I hereby claim the benefit under 35 U.S.C. 120 of any United States application(s) or 365 (c) of any PCT international application designating the United States of America, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in prior United States or PCT international application in the manner provided by the first paragraph of 35 U.S.C. 112, I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

U.S. Parent Application or PCT Parent Number	Parent Filing Date (MM/DD/YYYY)	Parent Patent Number (if applicable)

Docket No. R-222.00


DECLARATION -- UTILITY OR DESIGN PATENT APPLICATION
(37 CFR 1.63)

As a named inventor, I hereby appoint the following registered practitioner(s) to prosecute this application and to transaction all business in the Patent and Trademark Office connected therewith: Michael C. Schiffer, Reg. No. 30,215, Michael F. Fedrick, Reg. No. 38,799, C. Joseph Faraci, Reg. No. 32,350 and Janice Guthrie, Reg. No. 35,170.

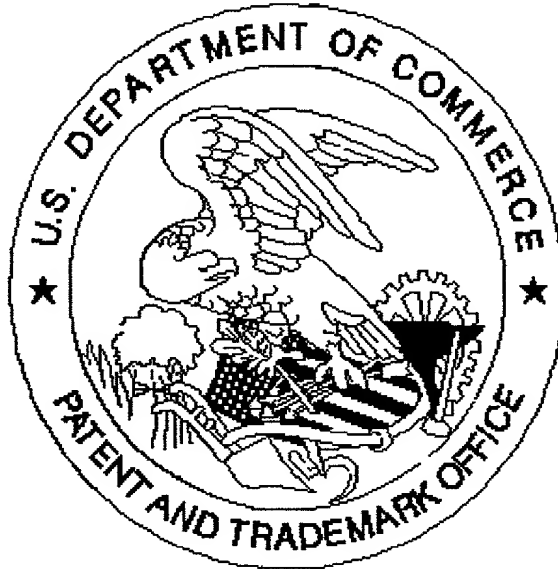
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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Name of Sole or First Inventor: Hans-Peter Schwarz Inventor's signature: _____ Date: _____ Residence: Schindlergasse 32 Vienna, Austria A-1180 Citizenship: Austrian Post Office Address: same	Name of Second Joint Inventor: Peter Turecek Inventor's signature: _____ Date: _____ Residence: Weidling, Hauptstrasse 59 g Klosterneuburg, Austria A-3400 Citizenship: Austrian Post Office Address: same
Name of Third Joint Inventor: Bernd Binder Inventor's signature:  Date: 01/03/02 Residence: Freyung 6/6/9 Vienna, Austria A-1010 Citizenship: Austrian Post Office Address: same	

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